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Upper Hudson River PCB Modeling System Overview

Presented by
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Presented to
LimnoTech, Ann Arbor, MI

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Introductions

- Jennifer Benaman – Overall Project Manager
  - Glens Falls Office
- Li Zheng – Hydro/Sedtran Project Manager
  - Montvale Office
- Peter Israelsson – FandT Project Manager
  - Cambridge Office
- Beth Lamoureux – Bioaccumulation Project Manager
  - Montvale Office
- Pete Oates – Sr. Engineer on FandT modeling
  - Montvale Office
- Raghav Narayanan – Engineer on Bioaccumulation modeling
  - Montvale Office

Goals for this Week

- Foster communication between the two consulting firms and establish key technical contacts
- Provide EPA's consultants with an understanding of the Upper Hudson River Model structure, development, and calibration
- Ensure that EPA's consultants can successfully execute all four models for calibration
- Lay the groundwork for understanding how to execute long-term simulations
- Encourage feedback from EPA's consultants on AQ's modeling approach, calibration, etc.

Introduction to UHR Modeling System

- Overview of modeling system
- Advances in UHR modeling
- Model domain and available data sets
- Model grid
- Model structure, development, and calibration

1999 Model of the Upper Hudson River

- Modeled Tri+ PCB
- Hydro/sedtran, fate and transport, bioaccumulation
- Simulated 1977 – 1999
  - Later updated to simulate through 2000
- Used to assess remedial alternatives
- Peer reviewed

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Objectives of Model Update

- Develop an enhanced model
  - Use vast data base compiled since original model development
  - Use advances in computational capability to better represent site conditions
- Provide a tool to evaluate impacts of the dredging program
- Provide a tool to potentially aid in operational and design decisions for Phase 2 design and implementation

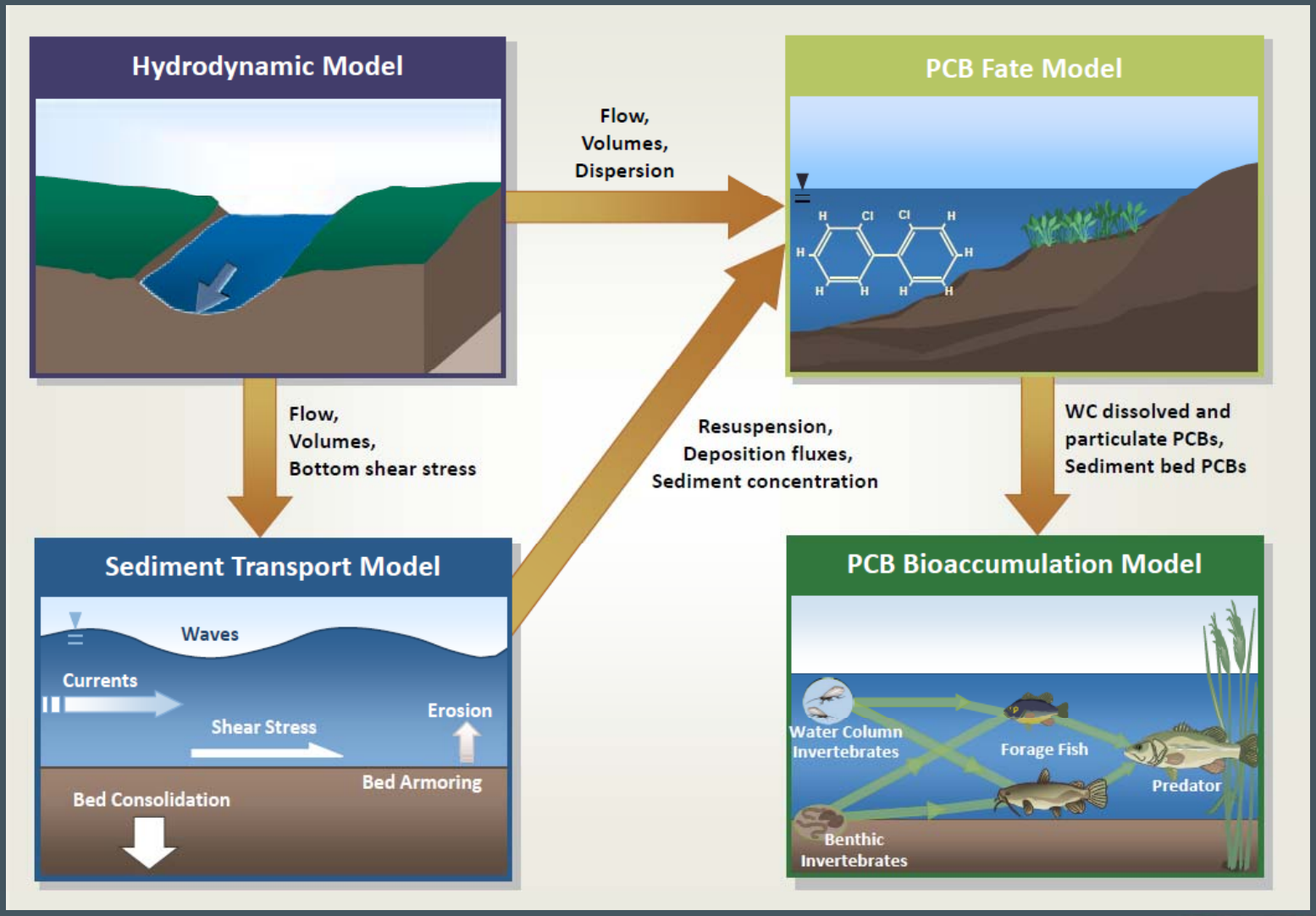
How Can We Use This Model?

- Investigate potential causes for issues during Phase 1 dredging
- Estimate impact of Phase 1 on rate of recovery of the river
- Evaluate benefits of alternative Phase 2 remediation
- Evaluate certain operational and/or design decisions in relation to resuspension and PCB water column and fish concentrations

Details About the Model

- Modeling two types of PCBs
  - Mono + Di homologs
  - Tri+ homologs (same as 1999 model)
- Calibrate PCB fate model using SSAP data as sediment initial conditions
  - Simulate from 2004 to 2008; compare predicted and observed water column PCB data and ability to replicate slow long-term decline
- Hydrodynamic, sediment transport, and PCB fate and transport models are closely coupled within EFDC model code

Model Framework



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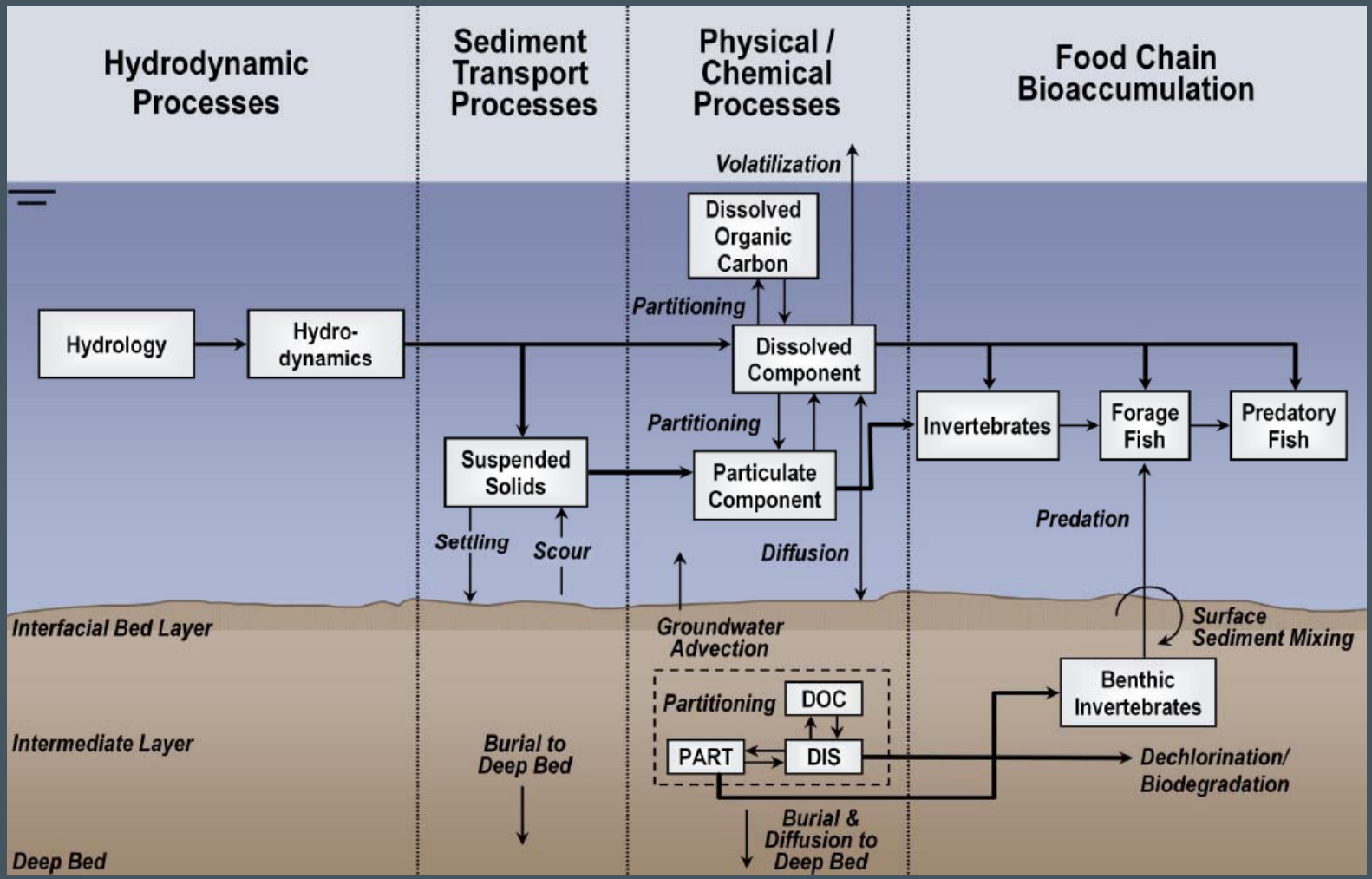
Conceptual Model of PCB Dynamics



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Advances in UHR Modeling

- Incorporates an extensive dataset collected for remedial design
- Grid consistency
  - Hydrodynamics, sediment transport, PCB fate and transport models all utilize the same grid
- Sediment transport
  - 4 sediment size classes
  - More realistic representation of bed armoring
- PCB fate and transport
  - Simulates Di- and Tri+ as aggregate groups
- Bioaccumulation
  - Food webs leading to 4 fish species

Upper Hudson River Model Domain and Available Data Sets

- Fort Edward, NY to Troy, NY
  - 40 miles
  - 8 Reaches separated by dams
- Data sets
  - Bathymetric surveys
  - Flow, stage heights, acoustic doppler current profiler survey
  - Sediment sampling and analysis program
  - Baseline monitoring programs (water and fish)

See full list in Table 2-1 of the UHR Modeling Systems Report (Anchor QEA 2010)

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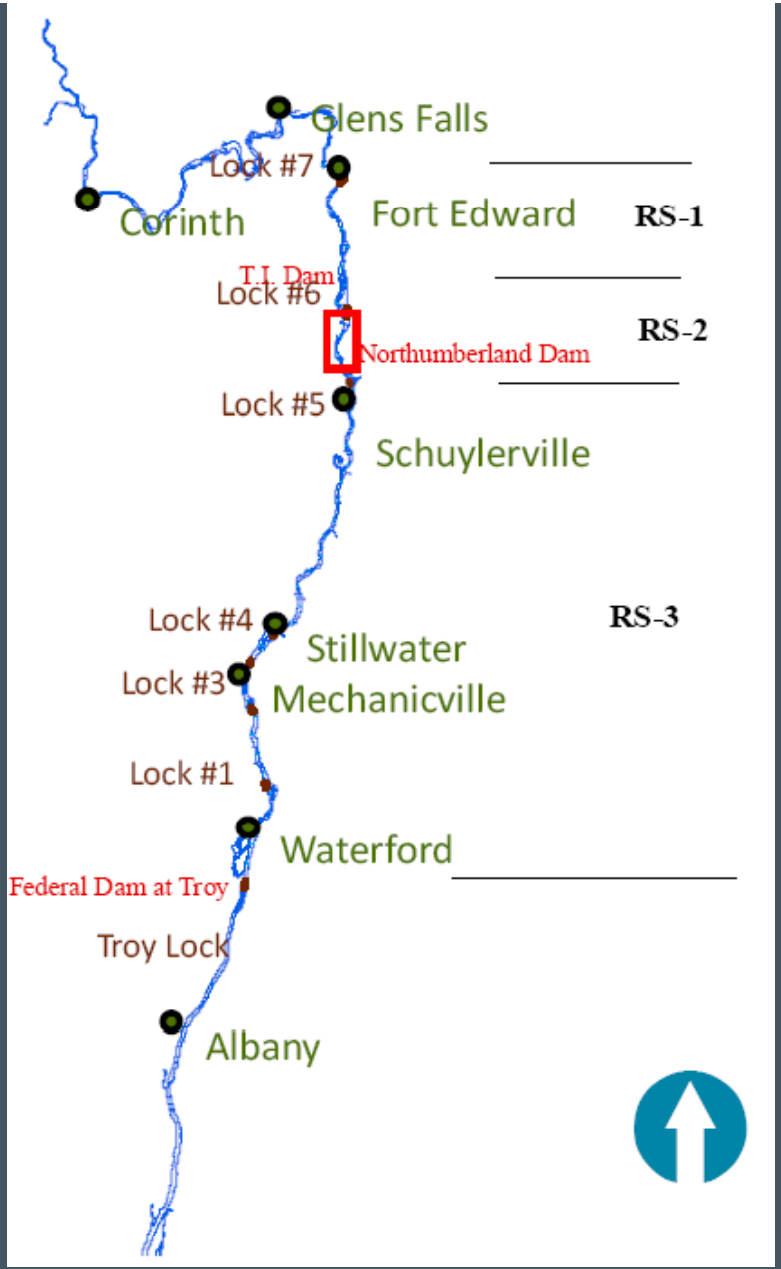
Glens Falls
Lock #7
Corinth
Fort Edward
RS-1
T.I. Dam
Lock #6
RS-2
Northumberland Dam
Lock #5
Schuylerville
Lock #4
RS-3
Stillwater
Lock #3
Mechanicville
Lock #1
Waterford
Federal Dam at Troy
Troy Lock
Albany

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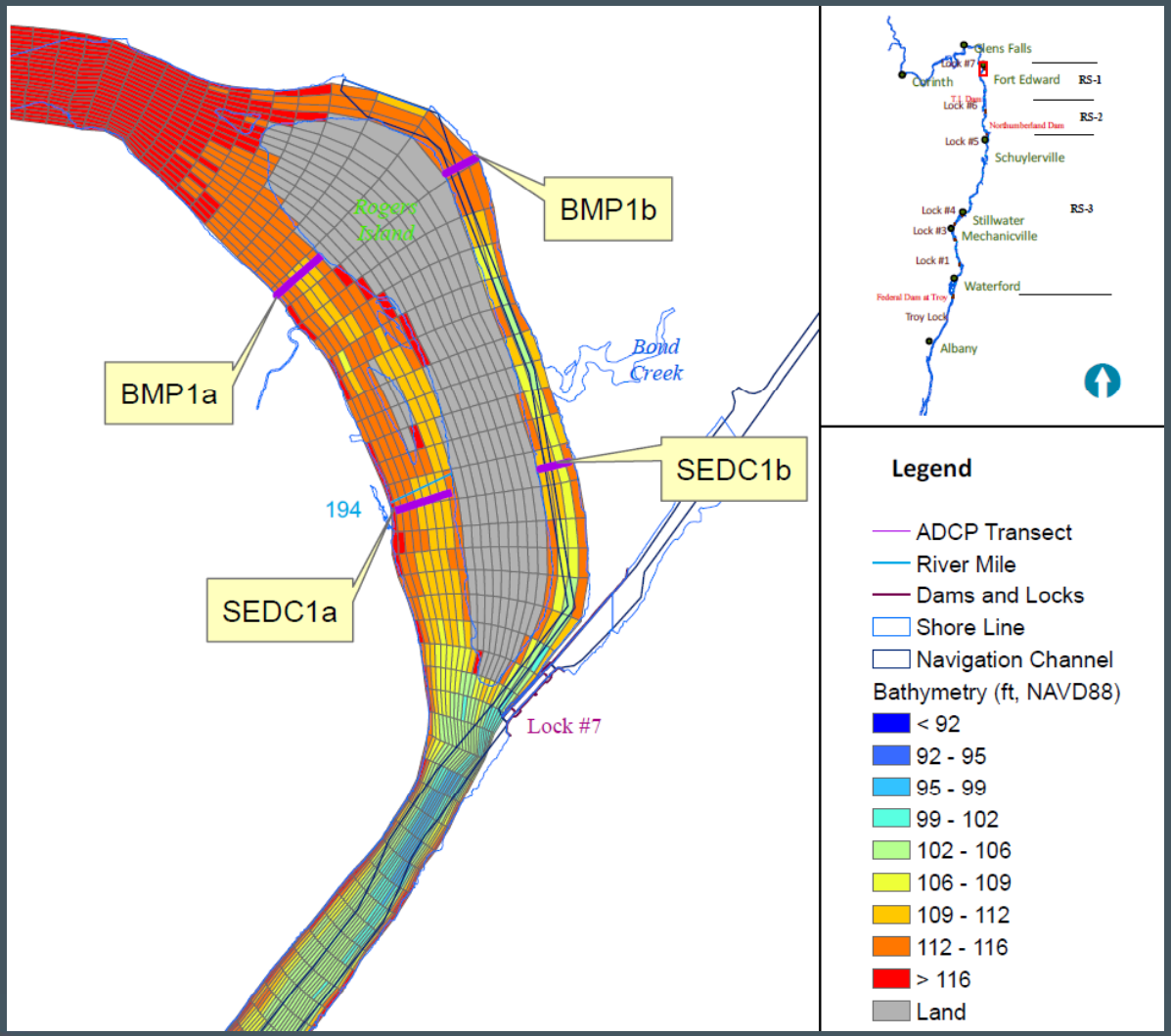
Model Reaches

Summary of Geometry for Hudson River Reaches 1 through 8

Reach	Upstream Boundary	Downstream Boundary	Length (miles)	Average Width (ft)
8	River Mile 195	Thompson Island Dam	6.8	730
7	Thompson Island Dam	Fort Miller Dam	2.2	930
6	Fort Miller Dam	Northumberland Dam	2.8	750
5	Northumberland Dam	Stillwater Dam	15.3	680
4	Stillwater Dam	Lock #3	2.3	1260
3	Lock #3	Lock #2	2.6	1090
2	Lock #2	Lock #1	4.1	900
1	Lock #1	Troy Dam	5.9	940

Model Grid



Top Portion of Reach 8

See complete grids in Figures 4-1 to 4-14 in the UHR Modeling System Report (Anchor QEA 2010)

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Model Cells per Reach

Reach	Number of Longitudinal Cells	Number of Lateral Cells	Average Cell Length (ft)	Average Cell Width (ft)	Typical Cell Aspect Ratio
8	230	22	160	33	5
7	51	22	240	42	6
6	130	22	110	34	3
5	260	22	310	31	10
4	40	22	300	57	5
3	50	22	280	49	6
2	105	22	200	41	5
1	150	22	210	43	5

General Calibration Approach

- Hydrodynamic model
  - Reproduce observed flows, depths and velocities
- Sediment transport model
  - Reproduce observed TSS conc., solids mass balances, flood scour and long-term deposition patterns
- PCB fate and transport model
  - Reproduce observed PCB conc. in water column
  - Reproduce sediment recovery rate in cohesive and non-cohesive sediments